Breakthrough involving rare earth elements could alter tech, mining worlds

October 27 2015, by David Goddard

A trio of students from the Department of Chemical and Biomolecular Engineering recently got the chance to work with scientists from around the country on a process that might make it easier and less expensive to obtain rare earth elements (REE).

Rare earth elements are a set of seventeen chemical elements in the periodic table—the fifteen lanthanides plus scandium and yttrium. These unusual metals are important in many technologies, including electronics, computers, clean energy, health care, transportation, national defense, and others. Despite their name, they are not all that rare, but unlike typical minerals they are rarely found in pockets or seams and are instead dispersed in low levels of concentration.

Recovering REEs can be difficult and expensive. At present, the United States imports nearly all of its rare earth elements.

Doctoral student Dave DeSimone and seniors Taylor Forrest and Nick Dement recently traveled to the Florida Industrial and Phosphate Research Institute (FIPR) to test a developmental process for recovering REEs from various waste streams from the phosphate industry.

These tests were made possible by collaboration between UT, Oak Ridge National Laboratory (ORNL), Idaho National Laboratory, and FIPR through the Critical Materials Institute. The project is coordinated by Professors Robert Counce and Jack Watson at UT, David DePaoli at ORNL, and Patrick Zhang at FIPR.

"Our interaction with UT students on this project has been valuable in two ways," said DePaoli. "The students have gained a vital educational experience, one that benefited the project through their analyses in prioritizing the phosphate byproducts in terms of their potential as REE source materials.

"Also, their recent tests have yielded valuable practical information toward the viability of REE recovery options that would not be accessible through typical laboratory experimentation."

Prior to the Florida investigation, four teams of UT seniors developed conceptual processes and ranked the potential for recovery of REE from phosphate waste streams. They briefed ORNL and FIPR weekly, producing reports of their design and analysis activities.

The project holds vast importance for the United States, as highlighted by the Department of Energy's Critical Materials Institute.

"The DOE found that four clean energy technologies—wind turbines, electric vehicles, photovoltaic cells, and fluorescent lighting—use rare earth elements that are at risk of supply disruption in the next five years," said Counce. "The objective of our work is to evaluate possible routes for recovery of rare earth elements from waste streams from phosphate processing."

In addition to the high-end devices, REEs also play key roles in such everyday items as magnets, rechargeable batteries, mobile devices, and superconductors.

Because of that, any way of making them more accessible could have drastic, far-reaching effects across a number of areas.

DePaoli said the United States currently imports nearly all of its rare earth elements, but that the method being developed could change that dramatically.

"While we're a major importer of rare earth materials, we're actually the world's second biggest producer of phosphates, with 32 million metric tons being produced each year," said DePaoli, who, like Watson, also serves as an adjunct professor in the Department of Chemical and Biomolecular Engineering at UT.

"This represents a significant potential source of relevant materials, since currently mined phosphate materials contain rare earth elements as well."

DeSimone, who leads UT's student team, described the basic concept behind the breakthrough, noting that the phosphate industry uses sulfuric acid as part of their process.

With the introduction of a stream of solvent alongside the acid, rare earth elements can be separated from the acid and brought into use. Doing so could potentially introduce a new source of rare earth elements while avoiding the need for new mining.

"That was one of the big plusses of this approach," said DeSimone. "Being able to tap into what is basically a byproduct of another process and harness it for such a critical resource is a major development."

Provided by University of Tennessee at Knoxville

Citation: Breakthrough involving rare earth elements could alter tech, mining worlds (2015, October 27) retrieved 25 April 2024 from https://phys.org/news/2015-10-breakthrough-involving-rare-earth-elements.html